The use of potassium chlorate and longan (*Dimocarpus longan*) flowering under south Florida conditions

Jonathan H. Crane, University of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida, U.S.A.

The problem.

Unreliable flowering is the major constraint to successful longan production throughout the world. Warm periods during south Florida's winter along with continued leaf flushing reduce or eliminate adequate longan flowering during many years. Potassium chlorate ($KClO_3$) has been used to improve flowering during the normal crop cycle and to "induce" off-season flowering of longan trees in Thailand, Taiwan, and other Southeast Asian countries. However, the appropriate rates, application methods, and timing of $KClO_3$ applications appears to vary with climate, soil, type, application method, time of year and cultivar. With this in mind a preliminary investigation was initiated to look at the effect of 4 rates of $KClO_3$ on subsequent flowering and fruit set of 'Kohala' longan.

The test.

A grove of 5-year-old 'Kohala' longan trees was used to investigate soil applied potassium chlorate on subsequent flowering and fruit set under south Florida conditions. Trees were about 12 to 16 ft tall, had a mean canopy ground area of 237.8 ft^2 (22.1 m^2), and were spaced 15 to 18 ft in-row by 20 ft between rows. Treatments included a soil-applied solution of $KClO_3$ at 0, 4.0, 8.0, or 12.0 oz per tree (0, 111 g, 221 g, or 332 g per tree) on 4 February 2000. About 16 gallons of $KClO_3$ solution was applied per tree. The percentage of flowering shoots and shoots with fruit set were counted 25 May 2000 and 11 August 2000, respectively. The amount of flowering shoots increased with the rate of $KClO_3$ solution from 0 (34%) to 4 oz per tree (92%) to 8 oz per tree (91%) and was slightly reduced at 12 oz per tree (84%) (Fig. 1). Similarly the percentage of shoots with set fruit increased from 0 (31%) to 4 oz per tree (88%) to and was slightly reduced at the 8 oz per tree (83%) and 12 oz per tree rate (79%) (Fig. 2).

A second grove with 17-year-old trees was also used to investigate the effect of soil applied $KClO_3$ on flowering and fruit set of much older (17 year old) 'Kohala' longan trees. Trees were about 16 to 18 ft tall, had a mean canopy ground cover area of 528.5 ft^2 (49.1 m^2) and were spaced 25 ft in-row by 25 ft between rows. Treatments included a soil-applied solution of $KClO_3$ at 0, 8.0, 17.0, or 26.0 oz per tree (246 g, 491 g, or 737 g per tree) on 2 February 2000. About 20 gallons of $KClO_3$ solution was applied per tree. However, this time the percentage of shoots flowering did not appear to differ dramatically among treatments and ranged from 61 to 76%. However, the percentage of shoots with fruit set was 1 1/2 to nearly 2 times greater for $KClO_3$ treated trees (71-80%) compared to non-treated trees (44%). The discrepancy between the percentage of terminals found to be flowering and with set fruit for any given treatment may be attributed to the random selection of terminals for rating flowering and fruit set.

Soil drenched applied $KClO_3$ generally improved the number of shoots flowering and setting fruit of 'Kohala' longan. More testing on the timing of application, stage of plant growth for optimum flowering response, rates for various tree sizes and cultivars,

application methods, affect on fruit quality, and long-term effects on tree health and production are warranted.

The recommendation.

Some readers may wonder why with these great results we have not advocated and advertised the effect of $KClO_3$ applications on longan flowering. There are several reasons for this:

1. These were two small experiments and represent results from 1 year of work. We have not had an opportunity to confirm these findings by repeating the experiments at least one more time. We generally will not make recommendations for something like this without having repeated the experiment at least once. Only one year of data is not enough information to determined if the results from $KClO_3$ applications will be consistent, i.e., happen year after year. Indeed, my communication with researchers in Southeast Asia indicates results from $KClO_3$ applications are not always repeatable.
2. What we don't know:
    a. Whether the material will work every time it is applied to the same trees. Repeated applications have been reported to cause tree decline.
    b. What happens when you apply it at different times of the year and/or at different growth stages of the trees (e.g., dormant, just flushing, etc.)?
    c. What the toxic and in-effective rates of $KClO_3$ are.
    d. Whether it works on all cultivars of longan.

We know from the literature and our contacts overseas that the rate of $KClO_3$ per tree varies with tree size, that too high a rate may cause defoliation, stem dieback, and tree death and, that the climate has a profound effect on whether $KClO_3$ delays, induces, or reverses a bloom. Some overseas research has suggested that although flowering may be induced at nearly any time of the year, fruit set is much reduced during the late fall and winter period. This is most likely due to a lack of sufficient pollinators and/or pollination and/or fertilization.

Background and safety issues on the use of potassium chlorate.

Used properly and following safe handling and storage procedures potassium chlorate may be an effective and useful tool in longan crop production. Potassium chlorate is an odorless, solid, fine crystalline, white colored material. A word of caution about potassium chlorate is in order however. This material is a powerful oxidizing agent and used in making explosives, matches, and pyrotechnics. This material can explode if handled improperly. When heated it emits toxic fumes of chloride and potassium oxide. It is categorized as a compound that requires precaution in handling and storage. These precautions include but are not limited to:

1. Must be stored in a dry, well-ventilated location away from direct sunlight, sources of ignition, combustible materials, heat, and incompatible materials. Incompatible materials include other fertilizers, reducing agents, finely divided metal powders, any corrosive materials, and organic materials.
2. Reseal containers immediately after use. Sealed containers with plastic are best. Keep containers dry.

3. Never store $KClO_3$ with fertilizers, pesticides, or other chemicals. They may set each other off causing a fire or explosion.

Potassium chlorate is categorized as an irritant, nuisance dust, and health hazard if improperly handled. Inhalation will cause irritation to the lungs and mucus membranes and symptoms include coughing, choking, and unconsciousness. Eye irritation symptoms include itching, watering, and redness, and possible corneal damage. Skin irritation symptoms include reddening, blistering, scaling, and itching; prolonged exposure may cause ulcerations. Avoid inhalation, dermal penetration, and ingestion. Chronic effects on humans: toxic to blood, kidneys, lungs, nervous system, liver, and mucous membranes. Safely handling the material includes:

1. Personal protective clothing: safety glasses or goggles, PVC gloves, impervious boots, apron or coveralls, NIOSH/MSHA approved dust mask/respirator. (note: do not use cloth or leather cloves as they will hold the material making the gloves potentially hazardous).
2. Handlers should wash their hands and face before eating, drinking or using tobacco products.
3. Good ventilation.

First aid information includes:

1. Eye exposure: remove contact lenses if present, immediately flush with water for 15 minutes, holding eyelids open. Seek immediate medical attention.
2. Skin/dermal exposure: wash with soap and water; get medical attention if symptoms persist.
3. Inhalation: remove person to fresh air; provide artificial respiration or oxygen if needed.
4. Ingestion: do not induce vomiting get immediate medical attention.

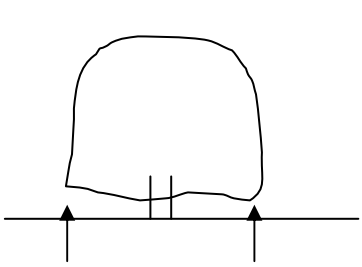
At present, a number of local chemical companies are investigating how they may obtain and sell large quantities of $KClO_3$ to growers. Please contact them directly. Currently, a number of investigators are looking at substituting $KClO_3$ with sodium chlorate ($NaClO_3$). Sodium chlorate is also an oxidizing agent and must be handled carefully. However, the reports are so far inconsistent as to how well it works and if it is a suitable substitute for $KClO_3$ for all regions and soil types where longans are grown.

How to use potassium chlorate: preliminary recommended steps for applying potassium chlorate as a soil drench to induce longan bloom

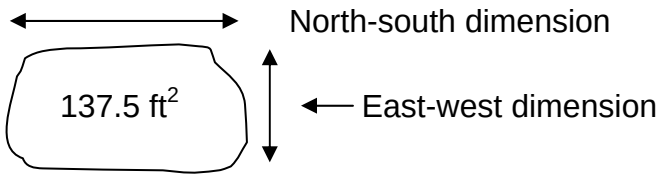
Jonathan H. Crane, University of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida, U.S.A.

We make no claim as to the effectiveness or effect of using KClO3 to induce longan flowering. Having stated that, here is a procedure for calculating the rate of material to use per tree and applying it with the idea of inducing longan bloom.

1. Remove the organic layer of leaves from under the tree canopy to the center of the tree rows.
2. Irrigate the grove a day or so before treatment.
3. Measure the NS and EW dimensions of 6 or more representative trees in the grove and calculate the canopy ground cover of each tree. Then take the average.

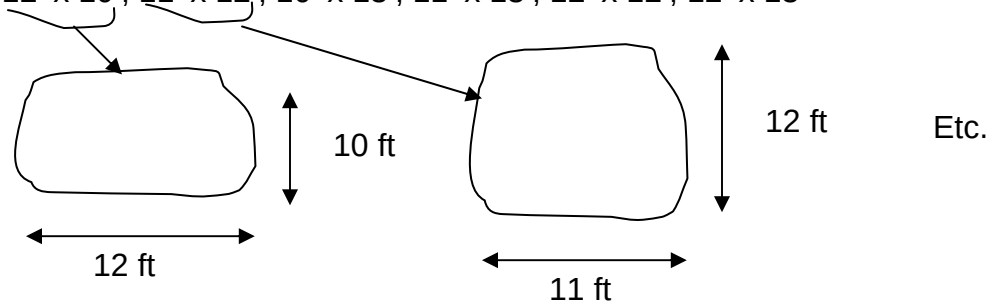


Side view of ground canopy area covered



Aerial view of ground canopy area covered

a. Ground area covered by six randomly selected trees:
12’ x 10’, 11’ x 12’, 10’ x 13’, 11’ x 13’, 12’ x 12’, 12’ x 13’



Etc.

$$\frac{120\ ft^2 + 132\ ft^2 + 130\ ft^2 + 143\ ft^2 + 144\ ft^2 + 156\ ft^2}{6} = 137.5\ ft^2/tree\ (12.8\ m^2)$$

b. Base the rate of $KClO_3$ based on mean canopy ground area per tree in grams or ounces per tree.

	Rate per unit tree canopy ground area covered		Rate per tree for trees with a 137.5 ft^2 canopy ground area	
Rate	g m^{-2} tree canopy	oz ft^2 tree canopy	Grams per tree (g)	Ounces per tree (oz)
Low	5	0.0164033	64	2 ¼
Medium	10	0.0328066	128	4 ½
High	15	0.049210	192	6 ¾

c. For example, if you use the 0.0328066 oz/ft^2 tree canopy rate (medium rate).

137.5 ft^2/tree x 0.0328066 oz/ft^2 = 4 ½ oz $KClO_3$ per tree

3. Carefully mix the 4 ½ oz of KClO3 in 15 to 20 gallons of water per tree and apply as a soil drench underneath the tree canopy from the trunk out slightly past the drip-line.
4. Irrigate for an hour or so after application.
5. Irrigate for several hours every 3 to 4 days for several weeks.

Trees may flower 3 to 10 weeks later.

(c:/ext/the mystery of potassium chlorate and longan.doc revised 2008)

5-12-08

Further notes:

1. Potassium chlorate will not work on trees that are actively growing (flushing).
2. This treatment does not work or work well on trees that are nutrient deficient (e.g., iron deficiency – green veins, yellow in-between the veins) or drought stressed.
3. We have observed that older trees (>12 years old) require a higher rate per tree than the rates we tested. That rate is about 13-16 oz/tree.

Source of potassium chlorate:

Advanced Scientific and Chemical
2345 S.W. 34 St.
Ft. Lauderdale, FL 33312
Tel: 1-800-524-2436

(c://extn/factsheets/longan/the use of KChl 2009.doc)